Appendix D1
Drilling Fluid Release Monitoring Plan
Horizontal Directional Boring

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Project Title:	Subject:
CABRILLO PORT LNG TERMINAL	**HDB Drilling fluid Monitoring**

Drilling fluid Release Monitoring Plan Horizontal Directional Boring

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1 INTRODUCTION

This Drilling fluid Release Monitoring Plan (Plan) is being prepared for the BHP Billiton, Cabrillo Port Liquid Natural Gas Terminal project. The project will include installing two 24-inch in diameter pipes to carry natural gas from the offshore Liquid Natural Gas (LNG) terminal to onshore locations. The pipes will be installed under the beach and surf zone areas by using HDB. This method of construction was selected as an alternative to installing the pipelines by open trenching. The use of HDB will mitigate impacts to the beach and nearshore environment that would result from open trenching.

The HDB Contractor has not yet been selected. The HDB Contractor will incorporate the measures presented in this Plan into their work plan. The equipment to be used in the HDB operation includes generally: HDB rig, power unit, control cab, mud pump, wire control system, backhoe, crane, and other miscellaneous support supplies and equipment.

Companion documents have been prepared that present, in greater detail, the expected HDB processes and conditions. Those documents are:

- *Preliminary Construction Procedure and Design for Horizontally Directionally Bored Pipeline Landfall,* prepared by Cherrington Corporation dated July, 2005 (BHPB Document No. WCLNG-BHP-DEO-TP-00-0001-0).
- *HDB Nearshore Pipeline Project Marine Operations,* prepared by Marine Project Management, Inc. dated July, 2005 (BHPB Document No. WCLNG-BHP-DEO-TX-00-002-0).
- *Preliminary Geotechnical Study Summarizing Subsurface Conditions at Southland Sod Farms,* prepared by Fugro Geoservices (BHPB Document No. WCLNG-BHP-DEO-GR-00-216-0).
- *Anchor Mitigation Plan for HDB Nearshore Pipeline Project Marine Operations*, prepared by Marine Project Management Inc. dated July, 2005 (BHPB Document No. WCLNG-BHP-DEO-TX-00-001-1).

2 PURPOSE OF THE PLAN

The purpose of this Plan is to establish monitoring and response criteria that will help reduce the potential for environmental effects of the HDB operation. The HDB operation uses drilling fluid to facilitate the boring of a borehole and installation of the bore pipes. The drilling fluid mixture typically consists of water and bentonite clay for fresh water mixtures and attapulgite clay for salt water mixtures. In some cases inert, non-toxic loss circulation materials (LCMs) are added to the mixture. These materials include cotton dust, cotton seed hulls, wood fiber, M-1 mica and cedar fiber. Specific information on all of these materials is presented in the Appendix of this Plan.

The fluid is composed of naturally occurring clay and water mixed at a ratio of 2 - 5% clay and 95-98% water. The clay is insoluble and made up of small particles that function as both a lubricant for the bore head and pipe and a sealant that fills the pore spaces surrounding the bore hole. Geologic conditions at the site have been investigated and found to consist of weakly to moderately consolidated sedimentary deposits, which are conducive to this type of operation and for which the use of clay/water-based drilling fluid is appropriate.

The HDB installation of each pipeline landfall segment will be accomplished as described in that plan titled *Preliminary Construction Procedure and Design for Horizontally Directionally Drilled Pipeline Landfall*.

While boring and/or reaming, most or all of the drilling fluids will return to the bore site or will be absorbed by the formation. However, it is possible that drilling fluids may reach the surface during the boring operation. Though the proposed Horizontal Directional Bore process is will significantly reduce the likelihood, as compared to standard Horizontal Directional Drilling, a surface fluid release will still be addressed. The boring process depends on the use of drilling fluid to run the bore motor or jet nozzles in the bore head to cut through the earth material, to seal off fractures in the formation and to lubricate the bore pipe during installation. The drilling fluid is pumped down the inside of the bore pipe and exits through the bore head. The fluid will then return to the bore site by being drawing into the outer casing being installed simultaneously. The fluid returning to the bore site is called “returns”. At the beginning of the bore a large percentage of the drilling fluid returns to the bore site. As the bore progresses, more of the returns are absorbed by the earth or rock formation, are contained in the bore casing and do not returned to the bore site. As the bore proceeds, returns may gradually decrease until a point where a complete loss of returns could occur. This loss will occur because of the porosity of the substrate and gravity. It is common to not have any drilling fluid return to the bore site during the majority of a bore without any release of the fluid to the surface. The drilling fluid is usually absorbed by the formation or is drawn down into fractures. It is important to understand that a complete loss of returns is a normal occurrence during drilling processes and does not necessarily mean the drilling fluid is coming to the surface or impacting the marine environment.

A key to controlling a loss of fluids that may reach the surface and limiting a release into waters of the State, including the ocean, is early detection and quick response by the Contractor. This Plan will identify the activities to be monitored and appropriate response actions to be taken help reduce the release of drilling fluid or LCM materials. The Plan outlines a process of monitoring the drilling fluid in order to identify a loss-of-returns situation and to determine if there is a release to the surface. Specific measures to be taken to reduce the amount and likelihood of surfacing drilling fluid, and other actions to be taken, are included.

3 TRAINING

Prior to the commencement of construction, the Contractor's and engineer's personnel will attend a training session on-site. The training session will be conducted by BHP Billiton and their representatives and will cover the following topics:

- the details of this Plan,
- the need for environmental protection,
- environmental resources located at or near the site,
- specific permitting conditions and requirements,
- the need to monitor the HDB operation,
- lines of communication,
- lines of authority and responsibility,
- the information the Contractor will need to provide to the HDB monitor and engineering site representative,
- contact names and phone numbers of the appropriate individuals and agencies, and
- events that need to be reported and to whom.

The Contractor will provide an overview of the boring operation in their work plan.

4 MONITORING OF HDB OPERATIONS

4.1 Overview of Monitoring Program

The objective of the release monitoring program is to quickly identify a release to the surface of drilling fluids and determine the size, extent and location of the release. Multiple data acquisition techniques were considered to accomplish this objective; these are:

- Fluorometery: A fluorescent dye (rhodamine WT) will be added to the drilling fluid mix once boring reaches the point at which the bore head is directly beneath the high tide line. A standard fluorometer will then be used to detect the presence of dye diffusing off any drilling fluids released to the water. Since dye can be detected in the parts per trillion range, very little is needed in order to mark the site of release; the natural ocean currents will spread the dye out into a plume which can be traced.
- Visual: Visual inspections will be conducted from shore, boat and by divers using an underwater video system to document the presence of a release of drilling fluids on the seafloor.
- Sediment Sampling: Grab samples would be taken in areas of suspected release on the seafloor.

The method to be used will depend upon the work zone where the bore head is located and sea or weather conditions. The three basic work zones which exist at this project site are: (1) the land portion of the bore from the rig to the mean high water mark, (2) the surf zone portion of the bore which is the area from the mean high water mark to just beyond the breaking waves, and finally (3) the open water portion from the edge of the surf zone out to the end of the bore, where vessel operation is not limited by water depth or typical surf conditions.

Weather and sea conditions are expected to follow three basic patterns: (1) clear with small to moderate swells [Beaufort scale 0 to 2], (2) clear with moderate to high swells [Beaufort scale 3 to 6], and (3) stormy with high to moderate swells [Beaufort scale 7 to 10].

Boring conditions and monitoring results will be reported continuously to the on-site agency monitor so that the agency monitor can provide notification to the agencies in compliance with their requirements. All incidents in which a release to the surface of boring materials or dye (see below) has been detected shall be reported promptly to the agency on-site monitor, who will be responsible in turn for reporting all incidents to the agencies (the California State Lands Commission, California Coastal Commission, and Regional Water Quality Control Board).

4.1.1 Monitoring "Decision Making Team" (DMT)

In order to increase communication on site and facilitate proper decision-making, a Decision Making Team (DMT) will be established. The DMT will be made up of the Contractor's superintendent, a BHP Billiton on-site representative(s), and the agency monitor. Their purpose will be to ensure proper communication and to facilitate the decision making process concerning the continuation of boring operations given certain conditions.

The Decision Making Team will have the responsibility of determining if boring operations should stop and/or what other corrective actions can be taken. The agency monitor will have the responsibility of determining if further agency involvement is necessary and to provide proper notifications to the agencies.

4.1.2 Monitoring Along the Land Portion of the Directional Bore

On the land portion of the bore visual inspection of the bore route through the beach will be used to look for evidence that drilling fluid has surfaced. The field team will keep track of the bore head position and will focus their visual inspection in this immediate area and in sensitive habitats such as the intertidal zone.

4.1.3 Monitoring in the Surf Zone

In the near shore surf zone, where boating may be precarious, the field team will utilize a portable fluorometer and grab water samples to determine if any drilling fluids have been released to the seafloor. By sampling down current of the bore route, the field team will be detecting dye transported from drilling fluids that have become entrained in the turbulent flow of the surf. Fluorometry will be in place so that sampling can begin as soon as the bore head is directly beneath the high tide line. For shoreline sampling, samples will be carried from the shore line to the fluorometer, which will be kept in a van or portable shelter.

Samples will be collected every 60 minutes in the wash zone with a plastic sampling container, while surf zone samples will be collected with sampling vials connected to a casting device (e.g., fishing pole). A single sample will be collected at equal distances upcurrent and downcurrent of the bore head position. Surf zone and shoreline samples will be collected at the same frequency as described above (every hour). Samples will be carried from the beach to the fluorometer and analyzed immediately.

4.1.4 Monitoring in Open Waters

Boat monitoring is proposed to begin when the bore head reaches beyond the surf zone (approximately 1,000 feet off shore). In the open waters the monitoring

equipment and manpower will depend on the current monitoring "condition" as defined later. For "Condition 1" monitoring, a vessel of opportunity will be used. It will be outfitted with the remote sensing hardware (fluorometer) and will take samples every 12 hours. For "Condition 2 and 3" monitoring, a dedicated survey vessel will be deployed. The dedicated survey vessel will be capable of operating under moderate weather conditions and equipped with a global positioning system, a first level detection system, consisting of remote sensing hardware (fluorometry), and capable of supporting a second level inspection system consisting of divers using an underwater video system. This arrangement should provide the greatest operating range for the monitoring crew and the quickest method for detection. Additional description of the equipment and monitoring operation is provided below.

The survey vessel and navigation system will operate concurrent with the boring operation, under all safe weather conditions, up to U.S. Coast Guard Small Craft Warnings, whenever boring activities are on-going. The first and second level of detection, remote sensing, will be operational within the same envelope. The third monitoring level, diver-controlled video, has an operational envelope of up to approximately 3-foot seas [Beaufort scale 0 to 4]. The diver-controlled video will be utilized, within the safety envelope, to confirm any anomalies detected by the remote sensing hardware. It is important to note that the ship's captain has the final responsibility of determining the safe sea conditions.

Periodic status reports will be provided by the on-site agency representative throughout the monitoring program. If dye is detected in marine waters, the report will describe the amplitude of contaminant concentrations, their distribution, and potential seafloor source. They will include contour maps of dye and contaminant levels in addition to tabulations of raw data. Contaminant volumes and dilution rates will be determined from mass-balance computations. Observed contaminant levels will be compared with pertinent regulatory limitations and with published marine-effects levels.

4.2 Equipment

- Survey Vessel
- Fathometer
- Recording Fluorometer
- Rhodamine WT Dye
- Diver-Controlled Underwater Video Camera
- Grab Sampler

4.2.1 Survey Vessel, Positioning and Navigation

Data collection will be conducted aboard a survey vessel. Vessel positioning will be accomplished using a GPS system. The system will provide reliable, high-precision positioning and navigation for a wide variety of operations and environments.

During Condition 2 and 3 monitoring operations, the survey vessel will be piloted along predetermined track lines, along and to either side of the bore route.

4.2.2 Fluorometry

To be able to detect the presence of drilling fluid released to the ocean, the drilling fluids will be marked with a soluble fluorescent dye tracer. Rhodamine WT, a biodegradable, fluorescent tracer that is extremely soluble in water and detectable in very small concentrations (less than 0.1 parts per billion) will be utilized for this project. The dye is supplied as a 20 percent aqueous solution. The dye will be mixed with the drilling fluid by the boring crew to approximately 5,000 ppb. The boring crew will visually monitor the dye concentration entering the borehole and in the returns to verify proper mix ratios. It has been shown in laboratory tests and in several prior boring projects that the dye will solubilize from a boring mud mixture made according to driller specifications. The released dye will be detectable using fluorometric techniques. The dye is also visible to the eye at high concentrations (~10 ppb).

Based on direct information from other bore sites in the State, the fluorescent tracer is highly visible when mixed into the drilling fluid. The dye turns the drilling fluid a light to medium pink color. However, it is not expected that the dye will be highly visible to the naked eye if it should surface in the ocean. The ocean turbulence will dilute the dye to the point where it is not easily seen, but will be detectable by the equipment up to a dilution of 1 part drilling fluid in 50,000 parts seawater.

Dye concentrations in the water column will be monitored using a fluorometer probe system linked to a laptop computer.

Since the fluorescence of dye varies with sample temperature, the water sample temperature will be recorded with the fluorescence data. These temperature data are used during real time processing to correct the dye concentration data for temperature variations.

For Condition 1 operations, samples will be taken every 12 hours. This will be done by a vessel of opportunity. Samples will be collected down current from the bore head. The vessel will be outfitted with portable remote sensing hardware (fluorometer).

For Condition 2 and 3 operations a dedicated survey vessel will be used. The fluorometer system installed aboard will monitor for the presence of dye. Sampling and testing will be conducted along the bore route, at depths between the bottom (~30') and the surface. Samples will be collected and fluorescence recorded from the bottom, mid depth, and surface every 30 minutes. The fluorometer is equipped with an alarm that will notify the sampling team of a detection between recorded

samples. The boat will always sample and maintain its position downcurrent of the bore head. Dye concentrations will be monitored as the vessel steams upstream toward the borehole corridor in a zigzag pattern. The GPS location of the maximum dye concentration will be recorded. Time, location, and concentration information will also be recorded at various other locations to delineate the lateral extent of the dye plume.

In the event of a dye detection, water samples will be collected at the location of maximum dye concentration and archived for future chemical analyses (if necessary).

The initial dye concentration of the fully mixed drilling fluids will be approximately 5,000 ppb. Based on results from past projects (e.g. AT&T's Japan-US and Global Photon's Global West, Tyco's Hermosa Beach), it is expected that solubilized dye concentrations in the water just over released drilling fluids will be in the range of 10 to 50 ppb. Dye concentrations will be used to assist in locating the release point prior to visual confirmation by following the dye concentration gradient to its maximum point.

Pre- and post-survey calibrations of the fluorometer will be conducted using standard solutions prepared with dye drawn from the same lot as used for the study. This will insure the maximum dynamic range of sensitivity for this project. Calibration solutions will be prepared employing Class A glassware as established by the National Bureau of Standards.

4.2.3 Diver-Controlled Underwater Video

Underwater video imaging will be collected using a diver-controlled video camera appropriate for shallow-water documentation; e.g., to about 60 foot depths.

The video camera will provide real-time observations of the seabed and underwater environment which will be recorded on VCR videotape. A time record on the videotape will allow direct comparison with navigational positions of the survey vessel.

The camera will be used to document the features of a suspected area of drilling fluid release.

The divers will descend to the bottom on the buoy down line and perform a circle search of approximately 25 feet. In addition to video documentation, the divers will collect seabed samples and assess bottom features.

4.2.4 Benthic Sampling

Sampling will be employed to confirm the fluorometry data by using a grab sampler deployed from the survey vessel or plastic tubes operated by divers, to collect

samples of surficial sediments. Whichever the deployment methodology, the corer will be inserted into the bottom, a sample collected, and returned to the surface. If drilling fluid is detected in the samples they will be measured, described and photographed.

5. MONITORING AND OPERATING CONDITIONS

5.1 Overview of HDB Operating Conditions

Geotechnical investigations were conducted on land. These investigations show favorable boring conditions. However, the porosity and composition of the subsurface soils and past experience indicate a possibility that loss of returns will occur. This loss of returns does not mean a release of bore fluid will occur. Rather, it indicates that the existing sediment formations are absorbing the material and that the boring pressures being used are not strong enough to force the drilling fluid back to the bore site. The bedding arrangement of this type of near shore zone typically has a high ability to absorb the drilling fluids into the existing formation, keeping the material underground and away from the surface. The following general parameters will be incorporated during the boring process.

1. Maintain adequate cover between the bore path and surface during the bore, except at entry and exit.
2. Adjust the viscosity of the drilling fluid mixture to match the substrate conditions.
3. Closely monitor boring pressures and penetration rates so use of mud pressure will be optimum to penetrate the formation.
4. When loss of circulation occurs, very little time will be spent trying to regain returns once under the sea floor. The data from geotechnical reports at this site indicate that loss of returns is likely, but the ability of the formation to absorb the drilling fluid and still make it possible to perform the boring is very good. Spending time trying to regain returns at a specific location may result in over pressurizing at a single point thus resulting in drilling fluid migration to the surface (i.e., frac-out).

The directional bore activities have been designed to avoid and otherwise minimize the potential for impact to sensitive areas. Additional protocols to be employed at the site include but are not limited to:

- Conducting on-site briefings for the work crew to identify the location of sensitive resources at the site.
- Educate all field personnel as to their responsibility for timely reporting of frac-out releases.
- Maintaining necessary response equipment on-site or at a readily available location and in good working order.
- Implement reasonable engineering methods to reduce the likelihood of drilling fluids being discharged to the ocean environment.
- Bore muds and cuttings remaining in the boreholes will be collected onshore to the extent possible. Debris removed from the bore pipe during pipe proving and brushing prior to commissioning the conduit will be collected and disposed of onshore.

- The contractor will, after completion of a borehole, dispose of the bore mud collected at an approved onshore location, or use it in a subsequent borehole. None of the excess bore mud or bore cuttings collected onshore shall be discharged or dumped into marine or onshore surface waters.
- The applicant will use the best available engineering techniques to minimize the volume of lubricants applied to the cables and discharged to the marine environment and to contain the lubricant within the conduit. Techniques include precise computation of required lubricant quantities and the use of lubrication equipment such as sealed containers, feeder systems, foam spreaders, front-end lubricant filled bags, and conduit inserts and collars. The cable installers shall use seawater as the cable lubricant.
- The permittee will not use toxic compounds, such as diesel pills or chrome-based lignosulfonates added to the bore mud, at any time prior to or during borehole boring.

5.2 Monitoring Conditions

The environmental monitoring field team will conduct monitoring operations in accordance with the flow chart and the table presented in this section. The flow chart and table present the operational measures and monitoring measures to be implemented given certain conditions and events.

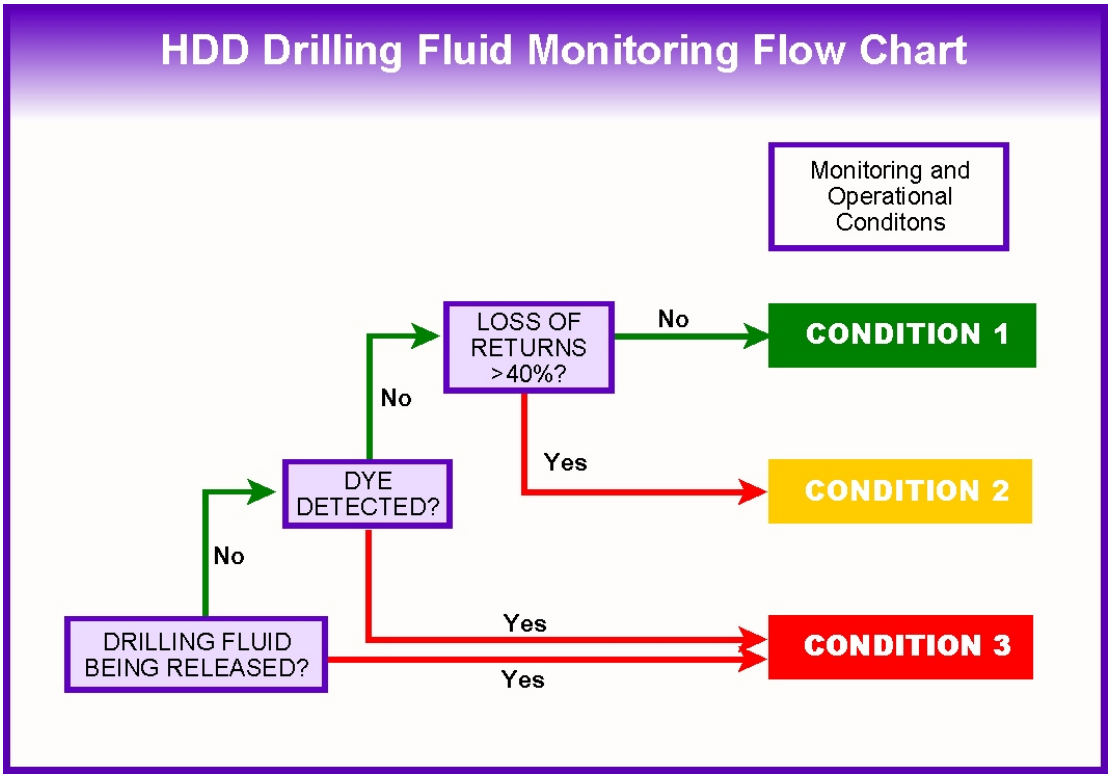

Table 5.2 Operational and Monitoring Measures

Con-dition	Status of Boring Returns	Dye Detected	Drilling fluid Release Detected	Operational Measures to be Implemented	Monitoring Operations
1	Normal drilling fluid returns[9]	No	No	Standard boring procedures	- Spot visual inspection of bore path over land. - Beyond water line fluorometry readings will commence from shore. - Beyond 1,000' off shore, fluorometry readings by vessel every 12 hours will commence if weather conditions permit.
2	Loss of drilling fluid returns exceeds 40%[9]	No	No	The Contractor will take appropriate measures to attempt to restore returns. These may include: - Modifying drilling fluid properties - Modifying pressure and volume - Advance or retreat bore pipe [1] - Introduce LCMs according to manufacturer's instructions [2]	- Visual inspection of bore path over land. - Between water line and 1000' off shore, fluorometry readings will continue from shore. **Plan A [3]** - Beyond 1,000' off shore, fluorometry readings by a dedicated vessel will commence. **Plan B [4]** If Plan A cannot be implemented the agency on-site representative, in consultation with the DMT [5, 6] and analysis of specific site conditions, may stop work until monitoring can continue.
3	Full returns or no returns	Yes	No/Yes (a release of drilling fluid is assumed if dye is detected until it can be confirmed otherwise).	Work will temporarily stop to locate and quantify the release as described in the monitoring operation. The Contractor will attempt to determine if a drilling fluid release is occurring. Additionally, the Contractor will take appropriate measures to attempt to prevent a possible drilling fluid release. These may include: - Modifying drilling fluid properties - Modifying pressure and volume - Advance or retreat the bore pipe [1] - Introduce LCMs according to manufacturer's instructions [2]	Determine if a drilling fluid release is occurring. If so, determine its location and the extent of the release. **Plan A [3]** Continue with monitoring method that detected the release and: - Continue fluorometer readings from shore - Beyond 1,000' off shore, fluorometry readings by vessel will continue. - Initiate grab sampling of ocean floor sediments. - Commence in-water survey including diver surveys. - Conduct shoreline survey for wash-up of drilling fluid. **Plan B [4]** If Plan A cannot be implemented the agency on-site representative, in consultation with the DMT [5, 6] and analysis of specific site conditions, may stop work until monitoring can continue.

General Notes:

- Dye will be injected for each bore once the bore head reaches the mean high tide level.
- Safety for boat operation based on Beaufort scale and sea state condition. The vessel captain is responsible for vessel safety and has the ultimate authority to make the decision to launch.

Footnotes to Table:

1. It may be desirable to advance or retreat the bore pipe to try and regain returns or reduce fluid loss.
2. The manufacturer of each LCM specifies the best methods of using the material. The Contractor will follow the manufacturer's recommendations when using LCMs.
3. Plan A: Plan A describes the measures that will be taken if weather conditions allow.
4. Plan B: Plan B describes the alternative measures that will be undertaken if weather conditions do not allow Plan A measures to be implemented. If agreed upon monitoring cannot be implemented and the specific site conditions and bore status warrant, the agency on-site representative may require that operations stop until the monitoring can be implemented. The decision will be based on the current boring conditions and potential for a release of drilling fluid.
5. An on-site DMT will be established and will include representatives from the project proponent, the Contractor, and the agency's on-site representative.
6. The agency's on-site representative will have the authority to stop boring operations based on reasonable analysis of the particular field conditions and bore status. The representative will consider the boring conditions,

the weather conditions and the possibility of environmental impact in their decision. The agency's on-site representative will have the authority to stop boring operations if they determine that conditions preclude effective monitoring that is required given the particular field conditions and bore status.

7. The bore hole itself will hold a certain amount of bore fluid. Additionally, a certain amount of drilling fluid will be absorbed by or lost into the formation. It is possible that returns will stop altogether. When the loss of returns reaches 40% beyond what is stored in the hole itself, monitoring condition will be elevated to Condition 2 and the agencies will be notified by the agency's on-site representative. If a loss of returns should reach 100%, the agencies will again be notified by the agency's on-site representative.

Grab samples from the shore will be obtained by wading into the water, if possible, or by casting the container beyond the wash zone to collect the sample.

6 MONITORING AND OPERATING SCENARIOS

6.1 Condition 1: Routine Monitoring

Routine monitoring will apply when the boring operations are proceeding within expected parameters. For the proposed HDB operation, a loss of returns of up to 40% beyond the volume held by the bore hole are considered normal as long as no dye or drilling fluid release have been detected. The routine monitoring will be conducted by the monitoring team consisting of BHP Billiton representative(s) and an on-site agency representative. The Contractor(s) and BHP Billiton monitor(s) will be responsible for supplying information to the agency's independent representative on-site. Using the information provided, the status of the boring operation will be determined. The agency on-site representative will inform both the Contractor and the field data collectors of the condition of the boring operation. This information will also be recorded in logs.

6.1.1 Operational Measures to be Implemented

The Contractor shall supply the following information to the monitoring team at the completion of each joint of pipe:

- Position of the boring head relative to the boring point of entry.
- Recording of the total volume of drilling fluid that has been pumped during the boring operation.
- Comparison of the current total volume of drilling fluid used and the estimated current total volume of returns.
- Equipment breakdowns and repairs.
- Any abnormal drilling fluid pressure at the time of occurrence.
- The type and quantity of drilling fluid components and dye being used.

6.1.2 Monitoring

During normal boring conditions, the type of monitoring necessary will depend on the location of the bore head. Periodic visual inspection along the bore path of the terrestrial portion of the alignment will take place throughout the bore operation. As the bore head advances beyond the waterline a tracer dye will be added to the drilling fluid and, periodic fluorometry readings will commence. While the bore head is below the surf zone, these readings will be taken by grab samples from the beach at a minimum rate of once per hour or more frequently if the boring status warrants. Once the bore head passes beyond the surf zone, readings will be taken from a monitoring vessel using a flow through fluorometer, or portable fluorometer and grab samples, at least once every 12 hours. If a release of drilling fluid or dye is detected, then the monitoring operations for Condition 3 will apply.

6.2 Condition 2: Loss of Returns Exceeds 40%

6.2.1 Operations Program

Loss of circulation or drilling fluid returns is expected. It is expected that the return of drilling fluid may end at some point along each bore. Geophysical information collected at the site indicates that the sediment geomorphology has the capacity to absorb large amounts of added material. Once the loss of returns exceeds 40% following sequence of operations will be put in place:

- The Contractor will notify the DMT of the loss of returns.
- The Contractor may attempt to regain returns.
- The Contractor, in consultation with the engineer and the monitoring team, will determine the appropriate actions to be taken. The Contractor's rationale of implementing the particular measures will be communicated to the DMT. The measures that may be used include the following:
  1) Modifying Drilling fluid Properties: The Contractor may determine that modification of the drilling fluid properties will aid in restoring the circulation. These modifications can take place in the form of altering the viscosity or gel strength of the drilling fluid.
  2) Advance or Retreat Bore Pipe: If returns are lost, the Contractor may elect to advance or retreat the bore pipe in an effort to restore returns.
  3) Introduce LCMs: LCM introduction into the drilling fluid may be desirable at this point. The possibility of success using LCMs to restore returns will depend on the boring and subsurface conditions at the time. If used, the LCMs will be used according to the manufacturer's recommendations. The supplier of each LCM has determined the most appropriate implementation technique for the material. The Contractor will carefully follow the supplier's recommendations to give the LCMs the best chance for success. The type of LCM to be used will be determined by the boring Contractor and approved by the on-site agency representative.
- If returns are recovered, boring will continue under Condition 1 status. However, the Contractor will proceed with the boring operation even after failing to recover returns unless boring is stopped by the agency on-site representative. Spending time trying to regain returns at a specific location may result in over pressurizing at a single point thus causing drilling fluid migration to the surface.
- If dye or drilling fluid is detected being released to the surface, Condition 3 operations will take effect.

6.2.2 Monitoring

Upon notification that the loss of returns has exceeded 40% the monitoring team will elevate to Condition 2 status and prepare for fluid release monitoring. Periodic visual inspection along the bore path of the terrestrial portion of the alignment will continue. As the bore head advances beyond the waterline a tracer dye will be added to the drilling fluid and, periodic fluorometry readings will commence. While the bore head is below the surf zone, these readings will be taken by grab samples from the beach at a minimum rate of once per hour or more frequently if the boring status warrants. Beyond 1000 feet, monitoring at Condition 2 status events will depend on sea and weather conditions. Either Plan A or Plan B will be used according to weather and sea conditions. If agreed upon monitoring cannot be implemented the and the specific site conditions and bore status warrant, the agency on-site representative may require that operations stop until the monitoring can be implemented.

6.2.2.1 Plan A Monitoring

Plan A will be implemented unless sea or weather conditions prohibit its implementation. Sea conditions are expected to allow Plan A to be implemented on most occasions. The sea conditions that restrict the use of the particular monitoring activity are given earlier in this document.

Once the bore head moves beyond 1000 feet off shore and weather and sea conditions permit, the monitoring team will activate a dedicated survey vessel that will begin using the remote sensing equipment near the location of the head of the drill. Concurrently, the diver video team will be alerted.

If the tracer dye is detected by the remote sensing equipment, the status will be elevated to Condition 3. The DMT will be notified of the detection and the appropriate agency notifications will take place.

If the survey vessel is unsuccessful in locating or detecting the presence of dye or drilling fluid, and circulation has been re-established by the driller, the status will return to Condition 1.

If a loss of circulation continues and does not cause a detectable release of drilling fluid or dye, the survey vessel will widen its search to outside the bore head location. A pass will be made on each side of the bore alignment. A log of all monitoring and boring operations shall be kept by the DMT and shall be available for review by regulatory agencies at all times. Estimated quantities of drilling fluid used when loss of circulation occurs shall be recorded.

If a release of drilling fluid is detected, the status will be elevated to Condition 3.

If agreed upon monitoring cannot be implemented and the specific site conditions and bore status warrant, the agency on-site representative may require that operations stop until the monitoring can be implemented.

6.2.2.2 Plan B Monitoring

Plan B monitoring will be used when sea and weather conditions do not allow Plan A to be implemented. If Plan A monitoring cannot be carried out and the specific site conditions and bore status warrant, the agency on-site representative, in consultation with the DMT, may require that operations stop until the monitoring can be implemented. The DMT will assess the current boring conditions and situation to determine if additional measures should be implemented. The DMT will discuss potential actions including continuing or stopping work. They will consider the weather conditions, the current boring conditions, the location of the bore head, the potential for significant environmental effects from a release, and the predicted weather patterns in their decision-making process. The agency's on-site representative will determine if further approval from the agency is necessary at this point.

If a drilling fluid release is observed, the status will be elevated to Condition 3.

6.3 Condition 3: Dye or Drilling Fluid Release Detected

This section applies in the case where dye or drilling fluid is detected based on Condition 1, 2, or 3 monitoring protocols.

6.3.1 Operations Program

- Boring will stop to determine what actions need to be taken and to take those actions.
- The Contractor, in consultation with the DMT will determine the appropriate actions to be taken. The Contractor's rationale of implementing the particular measures will be communicated to the DMT. The measures that may be used include the following:
  1) Modifying Drilling fluid Properties. The Contractor may determine that modification of the drilling fluid properties will aid in restoring circulation. These modifications can take place in the form of altering the viscosity or gel strength of the drilling fluid.
  2) Advance or Retreat Bore Pipe: If returns are lost, the Contractor may elect to advance or retreat the bore pipe in an effort to restore returns.
  3) Introduce LCMs: LCM introduction into the drilling fluid may be desirable at this point. The possibility of success using LCMs to restore returns will depend on the boring and subsurface conditions at the time. If used, the LCMs will be used according to the manufacturer's recommendations. The supplier of each LCM has determined the most appropriate implementation

technique for the material. The Contractor will carefully follow the supplier's recommendations to give the LCMs the best chance for success.

- During any boring shut-down period, the Contractor will be permitted to circulate drilling fluid periodically to prevent the boring equipment and pipe from seizing.
- Following consultation with the agency's on-site representative, boring will resume or if Plan A or Plan B monitoring (discussed later in this section) do not detect a drilling fluid release, boring will continue. If Plan A or Plan B cannot be implemented, the continuation of boring will depend on the decisions made by the DMT
- If the release has not stopped, boring will stop again, the measures will be reapplied as necessary, and the steps above will be taken in consultation with the DMT.

If the dye has been detected, but circulation has not been lost, and no drilling fluid release is detected, boring will continue.

6.3.2 Monitoring

Upon notification of the detection of the dye or drilling fluid, the monitoring team will elevate to Condition 3 status and prepare for fluid release monitoring. Normal monitoring using visual inspection and fluorometer will continue as described in Conditions 1 and 2. Monitoring of Condition 3 status events will depend on sea and weather conditions. This section is separated into Plan A and Plan B.

6.3.2.1 Plan A Monitoring

Plan A will be implemented unless sea or weather conditions prohibit the implementation. Sea conditions are expected to allow Plan A to be implemented on most occasions but not all. The sea conditions that restrict the use of the particular monitoring activity are given earlier in this document.

The survey team will mark the location of the head of the bore with a surface buoy and begin using the remote sensing equipment. Fluorometry measurements will continue in order to track the concentration gradient of dye back to the areas of the source of the release on the bottom.

Bottom sediments in the area of suspected release will be sampled with a grab sampler deployed from the same vessel. Samples will be retrieved and inspected onboard the vessel to determine whether drilling fluid is present. Samples will continue to be taken in this manner until either the presence of drilling fluid in the sediments is confirmed, or dye is no longer detectable in the water column.

The DMT will be notified of the detection and the appropriate agency notifications will take place.

If the survey vessel does not locate or detect the presence of dye or drilling fluid and the dye ceases to be detected, the status will return to Condition 1 or 2 as appropriate.

If the detection of the dye continues and there is no detectable release of drilling fluid, the survey vessel and/or divers will widen their search to outside the bore head location. A pass will be made on each side of the bore alignment. A log of all monitoring and boring operations shall be kept by the monitoring team and shall be available for review by regulatory agencies at all times. Estimated quantities of drilling fluid used when loss of circulation occurs shall be recorded.

6.3.2.2 Plan B Monitoring

Plan B monitoring will be used when sea and weather conditions do not allow Plan A to be implemented. If Plan A monitoring cannot be carried out and the specific site conditions and bore status warrant, the agency on-site representative, in consultation with the DMT, may require that operations stop until the monitoring can be implemented. The DMT will asses the current boring conditions and situation to determine if additional measures should be implemented. The DMT will discuss potential actions including continuing or stopping work. They will consider the weather conditions, the current boring conditions, the location of the bore head, the potential for significant environmental effects from a release and the predicted weather patterns in their decision making process. The agency's on-site representative will determine if further approval from the agency is necessary at this point.

7 HDB DRILLING FLUID CLEAN-UP

The contractor will stage onshore emergency spill cleanup equipment including but not limited to sorbent booms during borehole boring. The cleanup equipment and materials shall be deployed in the event of an accidental release of bore mud.

7.1 Bore Operations Procedures

Before a directional boring operation begins, the contractor and boring crew will be properly informed of the aspects of this HDB Monitoring Plan and of all agency permit requirements. The boring crew will be informed as to their obligation to immediately report drilling fluid releases and to follow the steps outlined in Section 6 of this plan at the first confirmation of the occurrence of a dye detect or drilling fluid release. The on-site agency representative will verify that spill containment materials are available and in good working order.

7.2 Response Equipment

All equipment required to contain and clean up a drilling fluid release will either be available at the work site or readily available at an offsite location within one (1) hour of the bore site. The equipment includes the following:

- On-site: Heavy weight plastic gravel filled and sealed bags (at least 20 bags);
- On-site: Geotek filter bags 10x12-foot size or equivalent (at least 3 bags per segment);
- On-site: 5 gallon hard plastic pails (minimum 5);
- On-site: One wide heavy-duty push broom;
- On-site: Three flat blade shovels;
- On-site: Silt fence and T-posts or straw bales, as appropriate;
- On-site: Five bales of 18" by 18" absorbent pads. The pads are 100% polypropylene fabric that absorb 11 times their weight in liquids. They absorb 10 gallons of liquid per bale of 100 pads.
- On-site: Plastic pipe, 4-foot long sections of 18 inch and 36 inch diameters;
- On-site: Portable pumps;
- On-site: Absorbent Skimmer Booms - Skimmers will float indefinitely before or after saturation with oils. Skimmers are made of 100% meltdown polypropylene fill that repels water. They absorb ten times their weight and can be used in lakes, streams, or on the ground. Each skimmer has a harness kit attached that is made of yellow polypropylene rope with grommets that are used to connect skimmers. Each boom is 8" by 10 feet;
- On-site: one 55-gallon clean drum, lined with polypropylene material (overpack). The drum can be used to store spill response materials until needed. When a spill occurs, all soiled pads, pillows, skimmers, contaminated soil, etc. will be placed in the sealed and labeled drum for approved disposal after the cleanup is accomplished;

- Offsite: A minimum of 100 feet of hose; and
- Offsite: Vacuum trucks (800 or 3,000 gallon).

The primary containment equipment (i.e., all of the above items except the vacuum trucks and 100 feet of hose) will be kept on-site at the bore location. Vacuum trucks and hose will be maintained on-site under the following circumstances: (1) the crossing contains sensitive species; or (2) the bore has experienced a previous dye detect or drilling fluid release. The boring contractor will arrange to have all offsite cleanup equipment within one hour of the landing site.

7.3 Field Response to Drilling fluid Release Occurrence

The response of the field crew to a drilling fluid release will be immediate and in accordance with procedures identified in this section. All appropriate emergency actions that do not pose additional threats to sensitive resources will be taken, as follows;

- Boring operations may stop, as outlined in Section 6;
- The on-site agency representative will be notified to ensure adequate response actions are taken and notifications are made;
- Any existing berms, barriers, or silt fence established will be strengthened, as necessary, to contain drilling fluids; and
- Response equipment stored offsite in readily accessible locations (e.g., fully equipped 800 or 3,000 gallon vacuum trucks and 100 feet of hose) will be mobilized to recover larger releases when needed.

7.3.1 Cleanup Response

All cleanup measures will be implemented under safe sea and weather conditions.

Immediately following detection of dye or a drilling fluid release the following actions will be taken:

- The offshore cleanup crew will consist of a minimum of three trained divers that will respond immediately after a release is detected and documented, as described above.
- Intensive monitoring, as specified in 6.3.2, of the release area by the survey vessel shall be implemented.

Divers equipped with specialized water lifts (pumps) and filter bags will be used to remove the discharged drilling fluid from the sea floor. The divers, using remote hoses will vacuum up the material pumping it through filter bags that will trap the clay sized particles. Each bag will be recovered onto a diving support vessel, brought to shore and disposed of at an approved offsite location. This is the most

efficient and effective way of removing the drilling fluid released to the benthic environment with the fewest potential impacts to infaunal organisms.

In the event a drilling fluid release occurs on land the release will immediately be contained with the appropriate containment. The drilling fluid will be transferred manually or by pump back to the bore site for reuse or into a storage tank and removed from the site.

The divers shall maintain records of the quantity of drilling fluid removed, the transferal of the material to a disposal facility and the daily status of cleanup operations. The contractor will be responsible for disposing of the vacuumed material and waste drilling fluids according to the local, state and federal regulations.

Records or manifests of the disposal shall be furnished to the agencies upon completion of the work.

7.4 Response Closeout Procedures

When the release has been contained and cleaned up, response closeout activities will be conducted at the direction of the on-site agency representative (and with approval of relevant agency(ies), as required), and may include the following:

- The recovered drilling fluid will either be recycled on-site or hauled to an approved Class II facility for disposal by the Owner's Subcontractor specializing in the removal, transport and disposal of drilling fluids;
- All sites will be returned to pre-project contours – erosion control measures will be applied as needed to ensure protection of the waters;
- Sump pits at bore entry locations will be filled and returned to natural grade; and
- All protective measures (fiber rolls, straw bale, silt fence, etc.) will be removed unless otherwise specified by the Inspector.

No recovered drilling fluids will be discharged into the ocean, streams or storm drains.

7.5 Bore Abandonment

Abandonment of the bore is a last resort measure that will be followed only when all efforts to control the drilling fluid release have failed. Steps that will be taken in the unlikely event that an incomplete bore must be abandoned are the following:

- If abandonment of the bore is determined to be the best course of action, all of the appropriate agencies will be informed as soon as possible.
- The as-built hole alignment will be determined to the extent practicable, and documented;
- A thick, grout plug will be pumped into the casing to securely seal the bore hole.

If the bore is abandoned, the DMT will meet to determine a course of action. The determination will then be passed on to the appropriate agency personnel for information and/or consent, as required.

APPENDIX A

Glossary of Abbreviations and Definition of Terms

Abbreviations

General:
DMT – Decision Making Team
HDB – horizontal directional boring
LCMs – loss circulation materials. See Appendix for material safety data sheets (MSDS).

Definition of Terms

For the purpose of this Plan, the following definition of terms shall apply.

Returns: Returns are the cuttings and drilling fluid that return to the HDB entry pit from the bore hole.

Loss of Returns: A loss of returns refers to the condition when no drilling fluid and cuttings are returning to the HDB entry pit or are flowing to the exit pit.

Release: When the drilling fluid is released to the surface of the ground or ocean floor. Drilling fluid that remains subterranean are not considered to be released.

Decision Making Team: An on-site Decision Making Team consisting of a representative from BHP Billiton, the HDB contractor and the on-site agency representative or monitor.

APPENDIX B

Agency Contact List

[to be completed prior to construction]

Agency	Primary Contact Name/Phone	Emergency Contact Numbers: Primary and Secondary	After Hours Contact Number

APPENDIX C

MATERIAL SAFETY DATA SHEETS (MSDS) for:

For Loss Circulation Materials (LCM's)
And
Drilling fluids

(note: Included are a few sample MSDS for the bentonite and LCM's that are typical to those used in HDB operations. Other similar products may be used. MSDS for any LCM's and drilling fluids used will be available on site.)

MSDS for other LCM's is available upon request.

MSDS to be provided once a contractor is selected and materials are known.

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